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Docket No.: 2328-050

PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

In re Application of
Inventor(s): Jian J. CHEN et al.

U.S. Patent Application No. 09/821,027 : Group Art Unit: 1763

Filed: March 30, 2001 : Examiner: CROWELL, ANNA M.

For: INDUCTIVE PLASMA PROCESSOR HAVING COIL WITH PLURAL WINDINGS AND METHOD OF CONTROLLING PLASMA DENSITY

TRANSMITTAL OF APPEAL BRIEF

Mail Stop Appeal Brief - Patents
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

Submitted herewith in triplicate is Appellants' Appeal Brief in support of the Notice of Appeal filed May 21, 2004. A credit card form is attached in payment of the $330 appeal brief filing fee. To the extent necessary, a petition for an extension of time under 37 .F.R. 1.136 is hereby made. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, to Deposit Account 07-1337 and please credit any excess fees to such deposit account.

Respectfully submitted,
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Attn: BOARD OF PATENT APPEALS AND INTERFERENCES

APPELLANTS' BRIEF (37 C.F.R. 1.192)

This brief is in furtherance of the Notice of Appeal, filed in this case on May 21, 2004.

The fees required under § 1.17(f) and any required petition for extension of time for filing this brief and fees therefore, are dealt with in the accompanying TRANSMITTAL OF APPEAL BRIEF.

This brief is transmitted in triplicate.

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1. *In re Rijckaert*, 9 F3d 1531, 1534, 28 USPQ 1955, 1957 (Federal Circuit 1993), page 9

2. *In Re Oelrich*, 666 F2d 578, 58, 582, 212 USPQ 323, 326 (CCPA 1981), page 9

2. *In re Roberston,* 169 F3d 743, 745, 49 UDSPQ 2nd 1949, 1950-1951 (Federal Circuit 1999), page 9

3. *Ex parte Levy*, USPQ 2nd 1461, 1464 (Board of Patent Appeals and Interferences 1990), page 9

4. *In re Mills*, 916 F.2d 6.80, 16 USPQ 2nd 1430 (Federal Circuit 1990), page 14

5. *In re Schreibier* decision, 128 F3d 1473, 44 USPQ 2nd 1429 (Federal Circuit 1997), page 22

6. *In re Swinehart,* 439 F2d 210, 212, 169 USPQ 226, 228 (CCPA 1971), page 22

7. *Hewlett-Packard v. Bausch & Lomb* case, 909 F2.d 1464, 15 USPQ 2nd 1525 (Federal Circuit 1990), page 23

I. Real Party in Interest

The real party in interest is Lam Research Corporation, a leading manufacturer of processors using plasma to assist in making integrated circuits. The Lam Research Corporation website is http://www.lamrc.com.

II Related Appeals and Interferences.

There are no related appeals and/or interferences.

III Status of Claims

Claims 1-25, 28-40 are pending. Claims 26 and 27 have been canceled. Method claims 1-10 are subject to a restriction requirement and have been withdrawn from consideration. All claims under consideration by the Examiner are rejected; claims 11 and 31 are rejected on the basis of anticipation, under 35 USC 102; claims 11-25 and 28-40 are rejected on 35 USC 103 because of obviousness. Hence claims 11 and 31 are rejected on anticipation and obviousness.

IV Status of Amendments

The amendment under 37 CFR 1.116, filed May 27, 2004, has been entered. Appellant submits with this Brief an amendment to cure an antecedent basis problem. Appellant will proceed on the presumption that this amendment will be entered.

V Summary of Invention

The invention relates to a plasma processor including vacuum chamber 10 and coil 24 (Figures 1 and 2, page 12, lines 12 and 13). The chamber holds workpiece 32, typically a semiconductor wafer or a flat panel display, such as employed in liquid crystal video and computer displays (page 12, line 23; page 2, lines 9-11). Coil 24, including a pair of electrically parallel connected windings 40 and 42, excites gas in chamber 10 to a plasma in response to RF source 26 supplying power to the parallel connected windings (page 13, lines 2-6; page 15, line 3; page 16, line 5; page 17, line 6). A variable impedance arrangement including capacitors 80, 82, 84 and 86 (Figure 2), is connected to the coils such that interior winding 40 has an interior terminal 46 connected to capacitor 80 and an exterior terminal 48 connected to capacitor 84 (page 17, line 15 – page 18, line 4). Exterior terminal 50 of winding 42 is connected to capacitor 82, while interior terminal 48 of winding 42 is connected to capacitor 84. Controller 29, including microprocessor 33, input device 41 and memory system 35, controls the output power of source 26 and the values electrical reactances in the form of capacitors 80, 82, 84 and 86 (page 13, lines 15, 16; page 15, lines 19-23).

Controller 29 controls the output power of radio frequency source 26 and the values of the capacitors 80, 82, 84 and 86 in a manner to provide more uniform electromagnetic fields between the coil and gas in chamber 10 that is excited by the electromagnetic fields to a plasma. By controlling the electromagnetic fields, greater uniformity of the plasma density incident on workpiece 32 is provided. In particular, greater uniformity of the electromagnetic fields and of the plasma density with regard to azimuth angle is provided by the invention (page 8, line 24-page 9, line 8).

The chamber is operated under different conditions, referred to as recipes, as a result of different gas species being introduced in the chamber to form the plasma and the chamber being operated with different pressures (page 13, lines 18-20). These different recipes require different conditions of the electromagnetic fields to achieve plasma uniformity. For different distributions of electromagnetic fields, controller 29 causes (1) RF source 26 to supply different amounts of total power to the coil, and (2) the values of capacitors 80-86 so the source supplies different relative currents to the parallel connected windings (page 18, line 23 – page 21, line 5). In other words, controller 29 varies (1) the total power that source 26 directly supplies to windings 40 and 42 and (2) the values of at least one of capacitors 80-86 to control the amount of current flowing in winding 40 relative to the amount of current flowing in winding 42. According to one combination of the output of power of source 26 and the values of capacitors 80-84, the current flowing in winding 40 is constant and the current in winding 42 is subject to change (page 7, lines 5-21; page 19, lines 5-15).

To assist in providing azimuthal symmetry, adjacent windings 40 and 42 have standing wave current maxima that are radially opposite from one another (page 11, lines 5 and 6; page 18, lines 14-16; page 24, lines 23-25). Control of the location of the standing wave current maxima in windings 40 and 42 results from controller 29 adjusting the values of capacitors 82 and 84. Controller 29 varies the output power of source 26 and the values of capacitors 80-86 to cause the current and hence the electromagnetic field associated with exterior winding 42 to exceed the current and electromagnetic field associated with winding 40. Alternatively, source 29 controls the output power of source 26 and the values of capacitors 80 -86 so that the current flowing in exterior winding 42 is less than the current flowing in interior winding 40, resulting in the electromagnetic field coupled by winding 42 to the plasma to be less than the field coupled by winding 40 to the plasma (page 20,

Table I, items b&c; page 21, Table II, items b&c). These different electromagnetic field configurations enable plasma uniformity to be achieved for different recipes.

In one configuration, the frequency of source 26 and the length of windings 40 and 42 are such that there are substantial standing wave current variations along the length of each winding. Such variations are illustrated by waveform 90, Figure 4 (page 24, lines 7-18). Control of the current maxima in windings 40 and 42 so they are oppositely disposed with respect to each other is particularly important in this configuration to provide azimuthal symmetry (page 24, lines 23-page 25, line 1).

In another configuration, the frequency of the RF source and the length of the windings are such that no substantial standing wave current variations are along the length of each winding, as indicated by waveform 92, Figure 4 (page 15, lines 15-18). Arranging the frequency of source 26 so that the wavelength of the energy associated with the source relative to the length of the windings so there are no substantial standing wave current variations along the length of each winding reduces problems associated with simultaneously varying the values of capacitors 80-86 (page 25, line 11-page 27, line 20).

VI Issues

A. Claims 11 and 31 are not anticipated by Chu et al (US 6,051,073)

B. An ancillary issue associated with claim 11 is that Chu et al does not disclose a controller coupled to a source for supplying power to plural parallel connected windings and variable impedance arrangements respectively coupled with the plural parallel connected windings for varying the currents from the source to the windings, wherein the controller (a) directly varies the total output power of the source and the total power the source supplies to the plural parallel connected windings and (b) varies values of the variable impedance arrangement so that for different distributions of electromagnetic fields that the source supplies to the coil, different amounts of total power and different relative currents are applied to the plural parallel connected windings.

C. An ancillary issue with regard to claim 31 is that Chu et al does not disclose a controller coupled with an AC source for supplying power to plural windings that couple electromagnetic fields to a plasma in a chamber, wherein the controller varies the total amount of power the source applies to the plural windings that are connected in parallel so that for different distributions of electromagnetic fields different amounts of current are applied to individual windings and different amounts of total power are applied by the source to the windings.

D. Chu et al (US 6,051,073) does not render the subject matter of claims 12, 32-35, 37 and 39 obvious.

E. Sato et al (US 5,907,221) and Tomioka (5,897,713) or Chu et al (US 6,051,073) do not render the subject matter of claims 11, 12, 31-35, 37 and/or 39 obvious.

F. Chu et al (US 6,051,073) and Chen et al (WO 00/00993) do not render the subject matter of claims 13-16, 18-25, 28-30, 36, 38 and/or 40 obvious.

G. Sato et al (US 5,907,221) and Tomioka (5,897,713) or Chu et al (US 6,051,073) and Chen et al (WO 00/00993) do not render the subject matter of claims 13-16, 18-25, 28-30, 36, 38 and 40 obvious.

H. Chu et al (US 6,051,073) and Van Gogh et al (6,579,426) do not render the subject matter of claims 17 and 18 obvious.

I. Sato et al (US 5,907,221) and Tomioka (5,897,713) and Van Gogh et al (6,579,426) do not render the subject matter of claims 17 and 18 obvious.

J. An ancillary issue with regard to issues D-I is that a *prima facie* case of obviousness is not established because an apparatus is capable of being controlled to achieve a particular result. The Examiner's position in this regard is contrary to decisions of the Federal Circuit, for example, *In re Mills, 916 F2d 680, 16 USPQ 2nd 1430 (Fed. Cir. 1990).*

VII Grouping of Claims

Separate arguments are presented for patentability of each of the claims, except for claims 35, 37 and 39. Appellants concede that claims 35, 37 and 39 rise and fall with the claims upon which they depend.

VIII Argument

ISSUES A, B, & C
CLAIMS 11 AND 31 ARE NOT ANTICIPATED BY CHU ET AL (US 6,051,073)

Chu et al does not disclose the claim 11 requirement for a controller coupled to a source for supplying power to plural parallel connected windings and variable impedance arrangements respectively coupled with the plural parallel connected windings for varying the currents from the source to the windings, wherein the controller (a) directly varies the total output power of the source and the total power the source supplies to the plural parallel connected windings and (b) varies values of the variable impedance arrangement so that for different distributions of electromagnetic fields that the source supplies to the coil, different amounts of total power and different relative currents are applied to the plural parallel connected windings.

The Examiner incorrectly says Fig. 2 and column 5, lines 48-column 6, line 16 of Chu et al disclose the foregoing features. An inspection of the relied on portion of the reference indicates Chu et al adjusts tuning capacitors 85, RF generator 66 or matching network 50 to maintain the uniformity of the generated plasma (col. 5, lines 53-56; also see col. 1, lines 62-col. 2, line 2, col. 2, lines 35, 36 and col. 4, lines 15-17). Maintaining the uniformity of the generated plasma results from the electromagnetic fields exciting the plasma being uniform, which is opposite from the claim 11 requirement for a controller that achievers different distributions of electromagnetic fields as a result of the controller directly varying the total output power of the source and varying the values of the variable impedance elements.

Since Chu et al has no disclosure of providing different electromagnetic field distributions, particularly by directly varying the source total output power and the values of capacitors 85 or impedances in network 50, the Examiner apparently must rely on inherency of this feature. The Examiner has not met the requirements to establish a proper rejection based on inherency.

The fact that a certain result or characteristic may occur or be present in the prior art is not sufficient to establish the inherency of that result or characteristic. In re Rijckaert, 9 F3d 1531, 1534, 28 USPQ 1955, 1957 (Federal Circuit 1993); in Re Oelrich, 666 F2d 578, 58, 582, 212 USPQ 323, 326 (CCPA 1981). To establish inherency, extrinsic evidence must make clear that the missing descriptive matter is necessarily present in the thing described in the reference and that it would be so recognized by persons of ordinary skill in the art. Inherency may not be established by probabilities or probabilities. The mere fact that a certain thing may result from a given set of circumstances is not sufficient. In re Roberston 169 F3d 743, 745, 49 UDSPQ 2nd 1949, 1950-1951 (Federal Circuit 1999). In relying upon a theory of inherency, the examiner must provide a basis in fact or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the prior art. Ex parte Levy, USPQ 2nd 1461, 1464 (Board of Patent Appeals and Interferences 1990).

The final rejection fails to comply with the foregoing requirements. The final rejection provides no rationale or evidence to indicate Chu et al has different electromagnetic field distributions as a result of a controller directly varying output power of a source and varying an impedance arrangement, as claim 11 requires. Since Chu et al is interested in maintaining plasma uniformity, the inference is that Chu et al does not have a controller for (1) directly varying the

source output power of generator 66 and (2) varying the values of capacitors 85 or impedance network 50 to provide different electromagnetic field distributions.

The Advisory Action includes the statement "Li et al. teaches that by controlling the power, plasma distribution is achieved (col. 12, lines 19-37)." Appellants do not know how to consider this statement because Li et al. does not appear to be of record. Further, the statement does not mean that Chu et al necessarily has a controller that directly varies the output power of RF generator 66 and that varies the values of capacitors 85 or impedances in matching network 50 to provide different distributions of electromagnetic fields.

Chu et al also does not disclose the claim 31 requirement for a controller coupled with an AC source for supplying power to plural parallel windings that couple electromagnetic fields to a plasma in a chamber, wherein the controller varies the total amount of power the source applies to the plural windings so that for different distributions of electromagnetic fields different amounts of current are applied to individual windings and different amounts of total power are applied by the source to the windings.

The Examiner incorrectly relies on Fig. 2 and col. 5, lines 48-col. 6, line 16 of Chu et al to disclose these features. However, Chu et al does not disclose applying different amounts of current to individual windings and different amounts of total power to the windings for different distributions of electromagnetic fields. As discussed in connection with claim 11, Chu et al has no

disclosure of providing different electromagnetic field distributions. Again, the Examiner apparently must rely on inherency, but provides no rationale or evidence to support her position.

ISSUE D
CHU ET AL (US 6,051,073) DOES NOT RENDER THE SUBJECT MATTER OF CLAIMS 12, 32-35, 37 AND 39 OBVIOUS.

Claim 12, dependent on claim 11, differs from Chu et al by requiring the controller to vary the total power of an RF source and the variable impedance arrangements so that for different distributions of electromagnetic fields generated by and supplied by the different windings to the plasma the current flowing in one of the windings remains substantially constant and the current in the remainder of the coil changes.

Independent claim 34 differs from Chu et al by defining a controller for varying the currents applied by an AC source to parallel windings of a coil for causing the current flowing in one of the windings to be substantially constant and the current in the remainder of the coil to change.

The Examiner, in finally rejecting claims 12 and 34, states that because the apparatus of Chu et al is capable of controlling the total power and the variable impedance arrangements in the different windings, it would have been an obvious choice of design to one of ordinary skill in the art to arrange the Chu controller so that the current flowing in one of the windings is substantially constant while the current in the remaining winding changes to control the distribution and uniformity of the plasma. The final rejection gives no reason for this conclusion, other than that the Chu et al apparatus is capable of controlling total power and variable impedance arrangements. This is an improper test for establishing obviousness.

The fact that references can be combined or modified is not sufficient to establish *prima facie* obviousness. *In re Mills*, 916 F.2d 6.80, 16 USPQ 2nd 1430 (Federal Circuit 1990). In the Mills case, the claims were directed to an apparatus for producing an aerated cementitious composition by drawing air into a cementitious composition by driving a pump at a capacity greater than a feed rate. The prior art disclosed that a feed means can be run at a variable speed. However, the Federal Circuit found that the mere fact that the prior art disclosed that a feed means can be run at a variable speed, does not require the output pump to be run at the claimed speed so that air is drawn into the mixing chamber and is entrained in the ingredients during operation. Although a prior art device "may be capable of being modified to run the way the apparatus is claimed, there must be a suggestion or motivation in the reference to do so." Based on the foregoing, the position of the Examiner that "The prior art only has to provide a structure that is capable of performing in the manner claimed and not necessarily have ever been intended to be used in this manner." is contrary to established law.

In the Advisory Action the Examiner says the motivation to provide a controller as set forth in claim 12 is to control the distribution and uniformity of the plasma. However, Chu et al does not indicate that plasma uniformity is achieved by the aforementioned requirement of claim 12. The Examiner has apparently relied on Applicant's disclosure to arrive at the conclusion that a controller which causes the current flowing in one winding to be constant while causing the current in the remainder of the coil to vary provides control for the distribution an uniformity of the plasma. The Examiner has also not indicated how one of ordinary skill would control the output power of the Chu

et al source and the values of the Chu et al impedance to achieve these results. Consequently, the rejection of claims 12 and 34 as being obvious over Chu et al have no basis in law or fact.

Independent claim 32 differs from Chu et al by requiring (1) plural parallel connected windings of a coil to be arranged so (a) one of the windings is an exterior winding located so electromagnetic fields generated by it are in proximity to a peripheral wall of the chamber, and (b) electromagnetic fields generated by the remainder of the coil are remote from the chamber peripheral wall, and (2) a controller arranged for varying the currents applied by the source to the windings for causing the electromagnetic field generated by the exterior winding to exceed the electromagnetic field generated by the remainder of the coil.

Independent claim 33 distinguishes over Chu et al by defining (1) plural parallel connected windings arranged so (a) one of the plural parallel connected windings is an exterior winding located so electromagnetic fields generated by it are in proximity to a peripheral wall of the chamber, and (b) the electromagnetic fields generated by the remainder of the coil are remote from the chamber peripheral wall, and (2) a controller arranged for varying the currents applied by the source to the windings for causing the electromagnetic field generated by the exterior winding to be less than the electromagnetic field generated by the remainder of the coil.

In rejecting claims 32 and 33, the Examiner says the Chu et al controller:

> is capable of varying the total power and the current in each winding. Therefore, it would have been an obvious choice of design to one of ordinary skill in the art to arrange the controller so that the current applied to the exterior winding is varied in order that the electromagnetic field generated by the exterior winding exceeds, is less than or is the same as the electromagnetic field generated by the remainder of the coil in order to control the distribution and the uniformity of the plasma, therefore controlling the process being performed within the apparatus.

The Examiner gives no rationale for this conclusion about obviousness. The mere fact that the Chu et al controller is capable of varying total power and current does not mean that Chu et al makes obvious what the Examiner says is obvious. The final rejection fails to provide the necessary rationale to establish a *prima facie* case of obviousness. *In re Mills*, *ibid.*

The Advisory Action says the motivation to modify Chu et al to include the features concerning (a) the electromagnetic field generated by the exterior winding exceeding the electromagnetic field generated by the remainder of the coil (claim 32) and (b) the electromagnetic field generated by the exterior winding being less than the electromagnetic field generated by the remainder of the coil is to provide a more uniform plasma distribution. However, Chu et al has no disclosure or suggestion that the fields of claims 32 and 33 provide a more uniform plasma distribution.

The above portions of both claims 32 and 33 include a further feature that Chu does not have and has not been considered by the Examiner, viz; that (a) one of the windings is an exterior winding located so electromagnetic fields generated by it are in proximity to a peripheral wall of the chamber, and (b) electromagnetic fields generated by the remainder of the coil are remote from the chamber peripheral wall. In Figures 1 and 2 of Chu et al, there at least two windings of antenna 46 that are exterior windings. Consequently, the requirement of claims 32 and 33 for the electromagnetic fields generated by the remainder of the coil (i.e., the portion of the coil that is not the exterior winding) to be remote from the chamber wall is not found in Chu et al. This is another reason why the rejection of claims 32 and 33 does not establish a *prima facie* case of obviousness.

ISSUE E

SATO ET AL (US 5,907,221) AND TOMIOKA (5,897,713) AND CHU ET AL (US 6,051,073) DO NOT RENDER THE SUBJECT MATTER OF CLAIMS 11, 12, 31-35, 37 AND/OR 39 OBVIOUS

Apparently the Examiner realizes the weakness of the anticipation rejection of claims 11 and 31, based on Chu et al, and attempts to supplement that rejection by relying on Figure 6 of Sato et al and the Tomioka reference.

As pointed out in column 1, lines 44-48, Sato et al is concerned with providing a uniform plasma ion density across an entire substrate surface in an inductively coupled plasma reactor without requiring installation of a completely new antenna in the plasma reactor. In the Figure 6 embodiment, the antenna includes eight exterior loops 150a-150h and three inner loops 150i-180k. RF generator 170 drives loops 150a-150k via reactive networks 165a-165k (that may be RF impedance matching networks) and variable capacitors 160a-160k, respectively. Power distribution controller 180 controls each individual capacitor 160a-160k. The user governs the RF power levels in each one of the independent antenna loops 150a-150k through the controller 180 (Sato et al, column 4, lines 19-21).

The Examiner incorrectly states that column 8, lines 34-37 of Tomioka et al teaches an inductive plasma processor comprising a controller 14 for directly varying the total output power the source supplies to the plural parallel connected windings. In fact an inspection of Figure 5 (a top view of the coil of Figure 4) and consideration of Tomioka et al at column 7, line 44 – column 8, line 8 indicates Tomioka et al fails to disclose the plural parallel connected windings set forth in the final rejection. In this regard, the Tomioka et al coil includes first and second spiral coils 32 and 33. Coil 32 is driven by RF power supply 7 having a frequency of 13.56 MHz. Coil 33 is driven by RF power

supply 10 having a frequency of 13.21 MHz. Because coils 32 and 33 are driven by different sources having different frequencies, they are not connected in parallel. The only other connections of coils 32 and 33 are to capacitors 6, 9 and 34. None of the connections to capacitors 6, 9 and 34 establish the plural parallel connected windings erroneously set forth in the final office action. For this reason alone, the rejections based on Sato et al and Tomioka et al fall.

Further, any modification of Sato et al as a result of Tomioka et al or Chu et al to arrive at the combinations of claims 11, 12, 31-35, 37 and/or 39 would have been unobvious. Sato et al is interested in attaining a particular result. He apparently attained that result without using a controller to vary the output power of source 180. The Examiner gives no satisfactory reason why one of ordinary skill would have modified the output power of source 180 of Sato et al. None of the references has a disclosure of varying power to achieve the claimed different distributions of electromagnetic fields that have been discussed supra in connection with claims 11, 31-33 or different currents of claim 34. The references, as a whole, do not make obvious the claim 11 requirement for: a controller coupled to the source and components for (a) directly varying the total output power of the source and the total power the source supplies to the plural parallel connected windings and (b) varying values of components of the variable impedance arrangements so that for different distributions of electromagnetic fields the source is arranged to supply different amounts of total power and different relative currents to the plural parallel connected windings.

There is no specific disclosure in Tomioka et al. of <u>varying</u> the output power of sources 7 and 10 so that for different amounts of total power, there are different distributions of electromagnetic fields, as independent claims 11 and 31 require. Because the Examiner has advanced no evidence or

rationale that such a feature is inherent in Sato et al or Tomioka et al, or Chu et al the rejection must fall.

The Examiner says the previously discussed limitations of claims 12 and 32-34 are obvious because the references are capable of controlling the total power and the variable impedance arrangements in the different windings. As discussed previously, the test for obviousness is not what something is capable of doing, but what is obvious to one of ordinary skill in the art. The Examiner has made no attempt to establish a rationale as to why the foregoing limitations are obvious. There is no motivation to vary the output power of source 180 as the Examiner improperly suggests; there is no suggestion in the references to modify the Sato et al output power. The Examiner says changing the Sato et al output power would provide greater plasma uniformity, but gives no rationale for that conclusion. In addition, Sato et al apparently thought the attained plasma uniformity to be satisfactory.

ISSUE F

CHU ET AL (US 6,051,073) AND CHEN ET AL (WO 00/00993) DO NOT RENDER THE SUBJECT MATTER OF CLAIMS 13-16, 18-25, 28-30, 36, 38 AND/OR 40 OBVIOUS.

Appellants concede that Chen et al discloses the individual features that dependent claims 13-15, 18, 36, 38 and 40 add to the claims upon which they depend. However, the coil configurations of Chu et al and Chen at al are so different that one of ordinary skill in the art would not have combined these references to arrive at the structures of claims 13-15, 18, 26, 28 and/or 40. In addition, there is no motivation to modify Chu et al based in the Chen et al reference to arrive at the combinations of these claims.

One of ordinary skill in the art would not have modified Chu et al as a result of Chen et al is because the Chu et al. and Chen et al. coils differ so extensively. As illustrated by Chu et al in Figures 3 and 5, small coils 46 of plasma sources 40 are offset and shielded from each other (column 7, lines 23-25) and fields from them are coupled through separate windows. Each plasma source 40 and coil 46 is associated with a particular, relatively small area of the plasma chamber. In contrast, the Chen et al coils (1) are generally co-axial (i.e., not off set) (2) are relatively large, (3) couple their fields through a common window and (4) are not shielded. Because the configurations of the Chu et al and Chen et al coils differ from each other so extensively, one of ordinary skill in the art would not have thought of modifying the Chu et al magnetic fields based on the Chen disclosure so that the location and/or maximum amplitude of the current in the different Chu et al windings are varied. Because each Chu et al coil couples a field to a small region in the chamber there is no need to vary the location and/or maximum amplitude of the current in the different Chu et al windings. The final rejection again erroneously says obviousness occurs solely because Chu et al "is capable of varying

the variable reactance of each impedance arrangement."

Because Chu et al says uniformity is attained by proper placing of coils 46, one of ordinary skill in art would not have modified Chu et al to vary the standing wave current location, as claims 13-15, 18, 36, 38 and/or 40 require. The Examiner combines the references without any acceptable rationale.

Curiously, claim 18 depends on claim 17 that has not been rejected on the combination of Chu et al and Chen et al. Instead claim 17 is rejected on the combination of Chu et al and Van Gogh (US 6,579,426.) Hence, there does not appear to be an antecedent basis for the rejection of claim 18 as a result of Chu et al and Chen et al.

The Examiner admits Chu et al fails to include an arrangement wherein one winding is an interior winding and another winding is an exterior winding surrounding the interior winding, as claims 21-23, 32, 33, 36 and 38-40 define. She relies, incorrectly, on Chen et al., to rectify the Chu et al. deficiency for this feature. The Chu et al arrangement, wherein each winding is associated with a different small region of the chamber and the different windings are shielded so they do not have RF interference with each other, is entirely incompatible with the Chen et al structure. As a result, one of ordinary skill in the art would not have modified Chu et al to include this Chen et al feature.

Independent claim 25 requires the source frequency and the lengths of the plural parallel coil windings to be such that there are no substantial standing wave current variations along the length of each winding, and the impedance arrangement coupled with each winding to be arranged for controlling the value of the standing wave current in the respective winding.

Independent claim 28 is broader by saying the source frequency and the length of the at least one coil winding are such that there are no substantial standing wave current variations along the length of the at least one winding.

Claims 16, 19 24, 29 and 30, and their dependent claims, 12, 15, 19 and 28, include the requirement about winding length and frequency.

Because neither the final office action nor the advisory action discusses features of claims 16, 19, 24, 25 or 28-30, vis-à-vis Chu et al and Chen et al, the Examiner has not even attempted to establish a *prima facie* case of obviousness regarding these claims vis-à-vis Chu et al and Chen et al.

The rejection of claim 20 based on Chu et al and Chen et al is wrong because claim 20 requires the power of the source and the values of reactances of the impedance arrangements to be such that (a) the maximum amplitude of a standing wave current in one of the windings differs from the maximum amplitude of a standing wave current in the remainder of the coil and (b) adjacent windings have standing wave current maxima that are radially opposite from one another. The Examiner ignores the fact that claim 20 requires adjacent windings to have standing wave current maxima that are radially opposite each other. Hence the Examiner has not attempted to establish a *prima facie* case of obviousness regarding claims 20 and claims 21-23 that depend on claim 20.

ISSUE G

SATO ET AL (US 5,907,221) AND TOMIOKA (5,897,713) OR CHU ET AL (US 6,051,073) AND CHEN ET AL (WO 00/00993) DO NOT RENDER THE SUBJECT MATTER OF CLAIMS 13-16, 18-25, 28-30, 36, 38 AND 40 OBVIOUS.

The rejection based on issue G appears to be an admission of weakness of the rejection of the same claims based on Chu et al and Chen et al. The rejection based on of issue G is equally weak.

The Examiner says:

> It would have been obvious to one of ordinary skill on the art at the time of the invention to vary the location of and the value of the maximum amplitude of a standing wave in the respective windings as taught by Chen et al in the apparatus of Sato et al in view of Tomioka et al or Chu et al since the controller of Sato et al in view of Tomioka et al or Chu et al is capable of varying the variable reactance of each impedance arrangement, and furthermore uniform plasma is achieved.

As indicated previously, this is an improper test for obviousness. *In re Mills, ibid.*

Appellants have previously indicated why Tomioka et al does not disclose the parallel coils the Examiner says it discloses and why Chu et al and Chen et al would not have been combined.

Sato et al is quite similar to Chu et al. because both disclose many windings, each of which is offset from the others to couple a separate magnetic field to a different small region of a chamber. In contrast, Chen et al is concerned with coils having relatively large co-axial (i.e., not off set) windings that produce magnetic fields in relatively large volumes of the chamber. Consequently, the rejections of claims 13, 18-24, 36 and 40 are wrong for the same reasons discussed for these claims in the rejection based on Chu et al and Chen et al.

The rejection based on the four references is deficient with regard to independent claims 25 and 28 and dependent claims 16, 19, 24, 29 and 30 that define the relationship between source frequency and winding length such that there are no substantial standing wave current variations

along the length of the winding.

To attempt to show obviousness of the aforementioned feature of claims 16, 19, 24, 29 and 30, pages 16 and 17 of the final office action sets forth the following rather absurd position:

> Furthermore, it is noted that the rejection is over apparatus claims and not method claims. The prior art only has to provide a structure that is capable of performing in the manner claimed and not necessarily ever have been intended to be used in this manner. Thus, the apparatus of Sato et al in view of Tomioka et al is capable of controlling the frequency and the length of the windings, and thus having no substantial standing wave current variations along the length of each winding is considered intended use.

If the source frequency were zero and/or no power were applied to the coil, no plasma would be generated. Hence, the position advanced by the Examiner to show obviousness is technically incorrect and one of ordinary skill in the art would not know from the applied art to make the winding length and source frequency such as to achieve the function of claims 16, 19, 24, 25 and/or 28-30. The position in the office action about apparatus is contrary to *In re Mills*, *ibid*, as is the position about a structure being capable of performing a function.

The *In re Schreibier* decision, 128 F3d 1473, 44 USPQ 2nd 1429 (Federal Circuit 1997), cited on page 17 of the final office action is inapposite. The *Schreibier* decision, deals primarily with a rejection based on anticipation under 35 USC 102 and is concerned with inherency. In fact, the *Schreibier* decision approvingly cites *In re Swinehart,* 439 F2d 210, 212, 169 USPQ 226, 228 (CCPA 1971) to indicate there is nothing intrinsically wrong with defining something by what it does rather than what it is. The *Swinehart* case was directed to a <u>structure</u> having a certain chemical compound and included a requirement for the compound to be in a product that was opaque to infrared energy. The prior art disclosed the compound, but failed to indicate the infrared opaque feature. The infrared opaque feature was thus the distinguishing feature of the claim over the cited art. The court found the claim had been improperly rejected.

The *Hewlett-Packard v. Bausch & Lomb* case, 909 F2.d 1464, 15 USPQ 2nd 1525 (Federal Circuit 1990), also cited in on page 17 of the final office action, is inapposite because the quoted sentence is clearly dicta. In this case, the court held the attacked claim to be valid and comply with 35 USC 103. The comment was made in response to an argument Bausch and Lomb advanced against the Hewlett-Packard assertion that Hewlett-Packard had an obligation to show "operational differences" of the claimed device over the prior art. The court replied by saying the Hewlett-Packard apparatus claim covers what a device is, not what a device does. The court did not preclude the possibility of a functional limitation giving meaning to an apparatus claim. After making the statement quoted in the Office Action, the court said "An invention need not operate differently than the prior art to be patentable, but need only be different." This statement clearly indicates that the court recognized that if an apparatus operates differently from the prior art, patentability can arise. Thus the quoted sentence in the Office Action, in addition to being dicta, was taken out of context.

The bald statement bridging pages 16 and 17 of the final office action that "it is well known in the art to alter the length of a winding to achieve a desired process" is without foundation and irrelevant. There is nothing in the record to support this statement. Further, altering the length of a winding to achieve a desired process does not mean it is obvious to make the length of a winding and the frequency of a source such that there are no substantial standing wave current variations along the length of the winding. Some advantages associated with this construction are discussed *supra* in the last paragraph of Section IV of this Brief. The combination of features of each of claims 16, 19, 24, 25, 29 and 30 is particularly applicable to these advantages.

The rejection of claim 20 based on the four references is wrong because none of these references discloses standing wave current maxima that are radially opposite from each other. The

Examiner has not attempted to establish a prima facie case concerning this limitation. The four references also fail to disclose the previously discussed electromagnetic field relationships of claims 21-23, that depend in claim 20.

ISSUE H

CHU ET AL (US 6,051,073) AND VAN GOGH ET AL (6,579,426) DO NOT RENDER THE SUBJECT MATTER OF CLAIMS 17 AND 18 OBVIOUS.

Claim 17, dependent on claim 12, defines specific series connections between the windings and first and second variable capacitors. Claim 18 requires the first and second capacitors of claim 17 to be arranged so their values control the magnitude and location of the maximum amplitude of a standing wave RF current in their respective windings.

The Examiner admits Chu et al is deficient with respect to claims 17 and 18 because Chu et al has no disclosure of each of the windings including first and second end terminals respectively connected to first and second capacitors. While it is true that Van Gogh discloses such capacitors, the capacitor connected to one terminal of the Van Gogh coil is a blocking capacitor that is variable to control RF voltage distribution along the coil 104 carried by shield 106 that protects the interior wall of chamber 102 from the material being deposited in chamber 102 (Figures 1 and 2, column 3, lines 62-67). An inspection of Figures 1 and 2 of Van Gogh indicates coil 104 has a large diameter, somewhat less than, but approximately equal to, the diameter of chamber 102. It is apparent that the large Van Gogh coil supplies all the energy to the plasma. In contrast to the Van Gogh relatively large coil, Chu et al employs several small plasma sources 40, each including winding 46. Each source 40 supplies energy in a non-interfering manner to only a small portion of the chamber.

Because of the differences in the Chu et al and Van Gogh structures, one of ordinary skill would not have modified Chu et al as a result of Van Gogh.

Further, cyclically shifting the voltage distribution around the numerous coils 46 of Chu et al, while maintaining an impedance match between these coils and source 68 would be a control nightmare that could be a deterrent to combining the references. Van Gogh recognizes the difficulties associated with controlling impedance matching of a single coil and cyclically shifting the voltage distribution by including the Figure 4 embodiment that includes a fixed blocking capacitor 308a (column 10, lines 54-63; column 11, lines 6-10; column 14, lines 21-34). Van Gogh blocking capacitor 308 is changed in repeating cycles during the deposition so as to cyclically shift the distribution of voltages around the coil 104 so as to increase the uniformity of sputtering rate and coil heating for each portion of the coil 104. In contrast, the values of series input capacitor 310 and shunt match capacitor 312 are varied to provide a close impedance match between coil 104 and the RF generator that drives the coil (column 5, lines 63-67). There is nothing in Van Gogh to indicate that varying the values of capacitors 308 and 310 controls the magnitude and location of a standing wave RF current in coil 104, as claim 18 requires.

ISSUES I & J

SATO ET AL (US 5,907,221) AND TOMIOKA (5,897,713) AND VAN GOGH ET AL (6,579,426) DO NOT RENDER THE SUBJECT MATTER OF CLAIMS 17 AND 18 OBVIOUS

The combination of Van Gogh, Sato et al and Tomioka et al to reject the previously discussed limitations of claim 17 is incorrect for reasons previously advanced. Appellant has shown that the Examiner's analysis of Tomioka et al is wrong. Sato et al is similar to Chu et al because both are concerned with numerous small coils. For the reasons advanced in connection with the argument for Issue H vis-à-vis modifying Chu et al as a result of Van Gogh, one of ordinary skill would not have modified Sato et al as a result of Van Gogh.

IX Conclusion

The Examiner has failed to show that Chu et al provides the different electromagnetic field distributions of claims 11 and 31.

The Examiner has used improper rationale to combine the various references for the numerous rejections applied against claims11-25 and 28-40.

The references fail to disclose the distinguishing features of claims 12, 21-23, 32-34 and the claims dependent thereon for the relative values of the electromagnetic fields produced by the windings and the currents flowing in the windings.

The references fail to disclose or make obvious the requirements of claims 16, 19 25 and 28-30 about the relative length of a winding and source frequency.

The references do not disclose or make obvious the claim 20 feature of adjacent windings having standing wave current maxima that are radially opposite from one another.

The Examiner's multiple rejections against the same claims demonstrate the weakness of the Examiner's positions. Reversal is in order.

To the extent necessary, Appellants petition for an extension of time under 37 C.F.R. 1.136. Please charge any shortage in fees due in connection with the filing of this paper, including extension of time fees, or credit any overpayments to Deposit Account 07-1337.

Respectfully submitted,

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Appendix of Claims

Claim 11 An inductive plasma processor for processing a workpiece, comprising a plasma excitation coil, the coil including plural parallel connected windings, a source for supplying power to the plural parallel connected windings, the source being connected to the plural parallel connected windings for causing current from the source to flow in parallel to the plural parallel connected windings, variable impedance arrangements respectively coupled with the plural parallel connected windings for varying the currents flowing from the source to each of the plural parallel connected windings, and a controller coupled to the source and components for (a) directly varying the total output power of the source and the total power the source supplies to the plural parallel connected windings and (b) varying values of components of the variable impedance arrangements so that for different distributions of electromagnetic fields the source is arranged to supply different amounts of total power and different relative currents to the plural parallel connected windings.

Claim 12 The plasma processor of claim 11 wherein the source is an RF source and the controller is arranged for varying the total power and the variable impedance arrangements so that for different distributions of electromagnetic fields generated by and supplied by the different windings to the plasma the current flowing in one of the windings remains substantially constant and the current in the remainder of the coil changes,

each of the windings including first and second end terminals and each of the impedance arrangements including first and second variable capacitors, each of the first capacitors being connected in series with its respective first terminal for supplying RF energy from the RF source to the respective winding, each of the second capacitors being connected in series between its respective second terminal and ground, the controller being arranged for varying the values of the first and second variable capacitors.

Claim 13 The processor of claim 12 wherein each of the impedance arrangements includes a variable reactance coupled to its respective winding, the variable reactance of each impedance arrangement being arranged for varying the location of the maximum amplitude of a

standing wave current in its respective winding, the controller being arranged for varying the values of the variable reactance of each impedance arrangement.

Claim 14 The processor of claim 13 wherein the source is an RF source, the frequency of the RF source and the length of the windings are such that there are substantial standing wave current variations along the length of each winding.

Claim 15 The processor of claim 12 wherein each of the impedance arrangements includes a variable reactance coupled to its respective winding, the variable reactance of each impedance arrangement being arranged for varying the value of the maximum amplitude of a standing wave RF current in its respective winding, the controller being arranged for varying the value of the variable reactance of each impedance arrangement.

Claim 16 The processor of claim 15 wherein the source is an RF source, the frequency of the RF source and the length of the windings being such that there are no substantial standing wave current variations along the length of each winding.

Claim 17 The processor of claim 12 wherein the source is an RF source, each of the windings including first and second end terminals and each of the impedance arrangements includes first and second variable capacitors, each of the first capacitors being connected in series with its respective first terminal for supplying RF energy from the RF source to the respective winding, each of the second capacitors being connected in series between its respective second terminal and ground, the controller being arranged for varying the values of the first and second variable capacitors.

Claim 18 The processor of claim 17 wherein the first and second capacitors are arranged so their values control the magnitude and location of the maximum amplitude of a standing wave RF current in their respective winding.

Claim 19 The processor of claim 12 wherein the source is an RF source, the frequency of the RF source and the length of the windings being such that there are no substantial standing wave current variations along the length of each winding, and each variable impedance arrangement

includes a single variable reactance coupled with each winding, the controller being arranged for varying the value of the variable reactance to control the maximum amplitude of the standing wave current in each winding.

Claim 20 A vacuum plasma processor for processing a workpiece, comprising a plasma excitation coil, the coil including plural parallel connected windings, a source for supplying power to the plural parallel connected windings, the source being connected to the plural connected windings for causing different parallel currents from the source to flow in the plural parallel connected windings, impedance arrangements respectively coupled with the plural parallel connected windings, the power of the source and the values of reactances of the impedance arrangements being such that (a) the maximum amplitude of a standing wave current in one of the windings differs from the maximum amplitude of a standing wave current in the remainder of the coil and (b) adjacent windings have standing wave current maxima that are radially opposite from one another.

Claim 21 The processor of claim 20 wherein each of the windings is arranged for coupling an electromagnetic field to plasma in the chamber, one of the windings being an exterior winding located so electromagnetic fields generated by it is in proximity to a peripheral wall of the chamber, the remainder of the coil being arranged so electromagnetic fields generated by the remainder of the coil are remote from the chamber peripheral wall, the controller being arranged to cause the values of the total power the source supplies to the coil and of the reactances to be such that the electromagnetic field generated by the exterior winding exceeds the electromagnetic field generated by the remainder of the coil.

Claim 22 The processor of claim 20 wherein each of the windings is arranged for coupling an electromagnetic field to plasma in the chamber, one of the windings being an exterior winding located so an electromagnetic field generated by it is in proximity to a peripheral wall of the chamber, the remainder of the coil being arranged so electromagnetic fields generated by the remainder of the coil are remote from the chamber peripheral wall, the controller being arranged to cause the values of the total power the source supplies to the coil and the reactances to be such that the electromagnetic field generated by the exterior winding is less than the electromagnetic field generated by the remainder of the coil.

Claim 23 The processor of claim 20 wherein each of the plural parallel connected windings is arranged for coupling an electromagnetic field to plasma in the chamber, one of the windings being an exterior winding located so an electromagnetic field generated by it is in proximity to a peripheral wall of the chamber, the remainder of the coil being arranged so electromagnetic fields generated by the remainder of the coil are remote from the chamber peripheral wall, the controller being arranged to cause the values of the total power the source supplies to the coil and of the reactances to be such that the electromagnetic field generated by the exterior winding is about the same as the electromagnetic field generated by the remainder of the coil.

Claim 24 The processor of claim 19 wherein the source is an RF source, the RF source frequency and the lengths of the windings are such that there are no substantial standing wave current variations along the length of each winding, the reactance coupled with each winding being arranged for controlling the value of the standing wave current in the respective winding.

Claim 25 A vacuum plasma processor for processing a workpiece, comprising a plasma excitation coil, the coil including plural connected parallel windings, a source for supplying power to the plural parallel windings, impedance arrangements respectively coupled with the plural parallel connected windings, the source frequency and the lengths of the windings being such that there are no substantial standing wave current variations along the length of each winding, the impedance arrangement coupled with each winding being arranged for controlling the value of the standing wave current in the respective winding.

Claim 26 (canceled):

Claim 27 (canceled):

Claim 28 A vacuum plasma processor for processing a workpiece, comprising a plasma excitation coil, the coil including at least one winding, a source for supplying power to the at least one winding, the source frequency and the length of the at least one winding being such that there are no substantial standing wave current variations along the length of the at least one winding.

Claim 29 The plasma processor of claim 28 wherein the coil includes plural parallel

windings, each having a length such that there are no substantial standing wave current variations along the lengths of the windings and further including impedance arrangements respectively coupled with the parallel windings and the impedance arrangement coupled with each winding being arranged for controlling the value of the current in the respective winding.

Claim 30 The plasma processor of claim 28 further including an impedance arrangement coupled with the at least one winding for controlling the value of the current in the at least one winding.

Claim 31 Apparatus for controlling distribution of electromagnetic fields for exciting a plasma in a vacuum plasma processor for processing a workpiece, the apparatus comprising an excitation coil for launching the fields, the coil including plural windings for coupling electromagnetic fields to plasma in the chamber, an AC source for supplying power to the windings for causing different parallel currents to flow in the parallel connected windings, and a controller coupled with the AC source for varying the total amount of power applied by the source to the individual plural windings of the plural parallel connected windings so that for different distributions of electromagnetic fields different amounts of current are applied to the individual windings and different amounts of total power are applied by the source to the windings.

Claim 32 Apparatus for controlling distribution of electromagnetic fields for exciting a plasma in a vacuum plasma processor for processing a workpiece, the apparatus comprising an excitation coil for launching the fields, the coil including plural parallel connected windings for coupling electromagnetic fields to plasma in the chamber, an AC source for supplying power to the windings for causing different parallel currents to flow in the parallel connected windings, the plural parallel connected windings being arranged so (a) one of the windings is an exterior winding located so electromagnetic fields generated by it are in proximity to a peripheral wall of the chamber, and (b) electromagnetic fields generated by the remainder of the coil are remote from the chamber peripheral wall, and a controller arranged for varying the currents applied by the source to the windings for causing the electromagnetic field generated by the exterior winding to exceed the electromagnetic field generated by the remainder of the coil.

Claim 33 Apparatus for controlling distribution of electromagnetic fields for exciting a plasma in a vacuum plasma processor for processing a workpiece, the apparatus comprising an excitation coil for launching the fields, the coil including plural windings for coupling electromagnetic fields to plasma in the chamber, an AC source for supplying power to the windings for causing different parallel currents to flow in the parallel connected windings, the plural parallel connected windings being arranged so (a) one of the plural parallel connected windings is an exterior winding located so electromagnetic fields generated by it are in proximity to a peripheral wall of the chamber, and (b) the electromagnetic fields generated by the remainder of the coil are remote from the chamber peripheral wall, and a controller arranged for varying the currents applied by the source to the windings for causing the electromagnetic field generated by the exterior winding to be less than the electromagnetic field generated by the remainder of the coil.

Claim 34 Apparatus for controlling distribution of electromagnetic fields for exciting a plasma in a vacuum plasma processor for processing a workpiece, the apparatus comprising an excitation coil for launching the fields, the coil including plural windings for coupling electromagnetic fields to plasma in the chamber, an AC source for supplying power to the windings for causing different parallel currents to flow in the parallel connected windings, and a controller arranged for varying the currents applied by the source to the windings for causing the current flowing in one of the windings to remain substantially constant and the current in the remainder of the coil to change.

Claim 35 The apparatus of claim 34 wherein the coil includes plural windings extending radially and circumferentially between a pair of excitation terminals connected for receiving power from output terminals of the source.

Claim 36 The apparatus of claim 35 wherein one of the windings is an interior winding and another of the windings is an exterior winding surrounding the interior winding.

Claim 37 The apparatus of claim 32 wherein the windings of the coil include plural windings extending radially and circumferentially between a pair of excitation terminals connected

for receiving power from output terminals of the source.

Claim 38 The apparatus of claim 37 wherein one of the windings is the interior winding and another of the windings is an exterior winding surrounding the interior winding.

Claim 39 The apparatus of claim 33 wherein the windings of coil include plural windings extending radially and circumferentially between a pair of excitation terminals connected for receiving power from output terminals of the source.

Claim 40 The apparatus of claim 39 wherein one of the windings is the interior winding and another of the windings is an exterior winding surrounding the interior winding.